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Physics Formal Lab Report Format

1. Title of Experiment
2. Your Name, Lab Partner's Names, Date and Class
3. Statement of Purpose for the experiment
4. Data Tables - complete with proper units, correct number of significant digits and proper labels
5. Sample Calculations - only one is to be shown for each new quantity listed in the tables and should be listed immediately following the data table the quantity appears in
6. Graphs - Show title, names and units of the variable quantities used in the relationship, relationship discussed clearly, curves or best fits, plot each data point clearly and label the axes. Do not connect the points with a straight line through the central region of the data points. This line does not necessarily have to touch any or all of the data points. A numerical answer must be completed on the data and the results displayed (linear regression on  $x$ ) on the graph
7. Error Analysis - a complete discussion of the potential and actual sources of error while performing the experiment. Identify and list the major sources close to the other ones. Then rank by order to the value of a student's best estimate. The calculation of the percentage, method of measurement, human fallibility, etc. Calculate the Possible Percentage Error of each measurement based on its tolerance for a typical measurement obtained in the experiment. The error analysis must be written in paragraph form
8. Conclusions - Report the final results of the experiment. (i.e. What did you prove or disprove? What did you learn as a result of doing the experiment? Was the purpose of the experiment carried out? Position at the end of the report.
9. Answer to questions - It is not necessary to write out the questions.

10. NOTE:  
 Since these are formal reports, to be best, or ideal, if the entire contents are typed and printed by computer. If this is not possible, or available to you, then the report MUST be NEATLY printed or handwritten in INK. SPELLING is IMPORTANT! Do not use good paper for the report as it is unacceptable. A loose page of paper is NOT what we need due to NEATNESS. All graphs must be produced on graph and plotted on grid paper. All lab groups are encouraged to submit a single group report but groups of 4-6 groups are allowed to produce their own individualized reports. It is of course totally acceptable.

# Sensitivity Analysis of Geologic Computer Models: A Formal Procedure Based on Latin Hypercube Sampling<sup>1</sup>

Thomas P. McWilliams<sup>2</sup>

*Mathematical models in which a response variable Y is calculated, usually via a computer program, as a function of input variables X<sub>1</sub>, X<sub>2</sub>, . . . , X<sub>k</sub> are encountered frequently in earth sciences literature. In many cases, uncertainty in the knowledge of the correct values of the input variables exists, leading to uncertainty in the correct value of the response. Sensitivity analysis procedures can be used to identify which input variable uncertainties contribute most to uncertainty in the response variable.*

*This paper presents the technique of Latin hypercube sampling, a structured, formal sampling process used in the sensitivity analysis procedure. Output resulting from the sample is analyzed using stepwise regression analysis, leading to identification of key input variables. Future data gathering activities can then be done efficiently, focusing on these variables. The technique is applied to a model, developed by Sudicky and Frind, which represents the flow of a contaminant through a porous media.*

**KEY WORDS:** sensitivity analysis, Latin hypercube sampling, stepwise regression, computer models.

## INTRODUCTION

This paper presents a structured sensitivity analysis procedure intended primarily for use with computer models where the value of an output or response  $Y$  is calculated as a function of a set of inputs or independent variables  $X_1, X_2, \dots, X_k$ . In many applications, particularly when  $k$  is large, values of all relevant input variables cannot be known with certainty. Uncertainty regarding  $X$ s leads to uncertainty in the actual value of the response variable. This uncertainty frequently can be reduced by obtaining more precise information regarding input variables. However, practical constraints involving time, cost, and other factors can limit just how much more information can be obtained. Con-

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## Hooke's Law Experiment

**Objective:** To measure the spring constant of a spring using two different methods.

**Background:** If a weight,  $W = mg$ , is hung from one end of an ordinary spring, causing it to stretch a distance  $x$ , then an equal and opposite force,  $F$ , is created in the spring which opposes the pull of the weight. If  $W$  is not so large as to permanently distort the spring, then this force,  $F$ , will restore the spring to its original length after the load is removed. The magnitude of this restoring force is directly proportional to the stretch,

$$F = -kx$$

The constant  $k$  is called the spring constant. To emphasize that  $x$  refers to the change in length of the spring we write

$$F = mg = -k \Delta l \tag{1}$$

In this form it is apparent that if a plot of  $F$  as a function of  $\Delta l$  has a linear portion, this provides confirmation that the spring follows Hooke's Law and enables us to find  $k$ .

An additional approach is possible. One definition of simple harmonic motion is that it is motion under a linear, "Hooke's Law" restoring force. Note that for simple harmonic motion, the period does not depend upon the amplitude of the oscillation. For such a motion, we have

$$T^2 = 4\pi^2 m / k \tag{2}$$

where  $k$  again is the spring constant,  $T$  is the period of the pendulum and  $m$  is the mass that is oscillating. Thus, the mass includes the mass of the spring itself. However, the entire spring does not vibrate with the same amplitude as the load (the attached mass) and therefore it is reasonable to assume that the effective load ( $m$ ) is the mass hung from the end of the spring plus some fraction of the mass of the spring. Based on similar experiments, one third of the mass of the spring is a good estimation of the effective load due to the spring, thus

$$m = m_{load} + m_s = m_{load} + \frac{1}{3} m_{spring}$$

where  $m_{eff}$  is the effective load of the spring. Using this in Eq. (2), we find

$$k = \frac{4\pi^2 (m_{load} + 1/3 m_{spring})}{T^2} \tag{3}$$

The effective load of the spring can be determined for a particular spring using the following process. The equation for  $T^2$  can be written in terms of  $m_{load}$  and  $m_s$ ;  $m_s$  can then be determined from a graph of  $T^2$  versus  $m_{load}$ . Note that this assumes that  $m_s$  is constant.

# PHYSICS LAB WRITE-UP FORMAT

## INTRODUCTION

*Labs are the basis for our understanding of the key concepts in physics. Here are the guidelines for success in writing a quality lab report.*

1. All laboratory reports are to be written in your bound lab notebooks.
2. The names of all members of your lab team and the date the investigation was performed is to be written in the upper left hand corner of the first page of each report.
3. An appropriate and descriptive title for the report should be placed on the first page of the report.
4. Only use the right hand pages for the formal report. The left hand pages may be used for rough calculations or other notes.
5. Each of the following sections of the laboratory report should be prefaced with the section names.
6. Any data tables or graphs that are generated by the printer should be neatly attached to lab-book.

## LAB FORMAT

### Purpose

This is a statement of the problem to be investigated. It provides the overall direction for laboratory investigation and must be addressed in the conclusion.

### Equipment

- A list of all laboratory equipment used in the investigation.
- A detailed and labeled diagram to illustrate the configuration of the apparatus.

### Procedure

- Identify and name all experimental variables, both independent and dependent.
- Briefly describe how the independent variables are controlled.
- Someone who was not present during the lab should be able to understand how the experiment was performed and be able to reproduce the results by reading your procedure.

### Data

- Data measured directly from the experiment.
- Derived values obtained by way of mathematical manipulations (for example: average values, or unit conversions) or interpretations of any kind should be included in this section of the report as well.
- A sample calculation must appear describing the method of obtaining all derived values.
- The units for physical measurements in a data table should be specified in column heading only.

### Data Analysis

- Include all graphs, analysis of graphs, post laboratory calculations and percent errors.
- All graphs should have a title, labeled coordinate axis and units.
- Unusual results or trends should be noted and explained if possible.
- State the meaning of the slope and discuss the significance of the vertical-intercept when appropriate.
- Include mathematical models (equations with meaningful units) that describe the graphs.

### Conclusion

- Discuss the results of your experiment including a justification of its successes or failures.
- Discuss any questionable data or surprising results.
- Explain the possible source of any error or questionable results.
- Suggest changes in experimental design which might test your explanations.

## Physics Laboratory Report Sample

PHYS 221 Lab Report

Newton's Second Law

Your Name:

Partner 1 (Last Name):

Date Performed:

Date Due:

Date Submitted:

Lab Section (number):

Instructor (Name):

### Introduction

We verified Newton's Second Law for one-dimensional motion by timing an accelerated glider moving along a frictionless track. We varied both the acceleration time and the mass of the glider. We found that the acceleration of the glider was directly proportional to the force applied to the glider, as expected with Newton's second law.

### Experimental Procedure

Description of the Apparatus:  
A sketch showing the essential elements of the apparatus is presented in Figure 1 below.

Formal lab report example. Formal report chemistry lab example.

The lab report is basically a document that is made to show the results of the experiments that the students do by themselves in the laboratory. There are several rules for writing lab reports, but there are no hard and fast rules. There may be some changes in creating lab reports on different subjects. After reading this article we will learn how to create a lab report on physics and what we need to keep in mind. We've attached a physics lab report that lets you get an idea. Main Sections of A Physics Lab ReportIn order to write a physics lab report, we need to split the whole lab report into parts, and these parts play a big role in performing the experiment. First, we have to write down how to start the experiment, then we have to give an idea of what steps we have to follow, then we have to present the results obtained from the experiment, and at the end, we have to express what we have understood. The following is a list of the parts that need to be worked on to write a physics lab report:ObjectiveTheoryList of components or equipmentDiagramStepsData TableGraphResultConclusionA lab report is basically based on the above points, but in some cases, more can be added. But writing a simple report does not require more than that. Below is a detailed discussion of these parts so that you can understand what to write about in these parts.(ads1)Objective SectionThis section provides an idea of what the lab report is being written for and what the experiments will prove. For example, verification of Ohm's law lab report's objective section can be: "The objective of the experiment is to verify that the current and voltage are directly proportional using a 1 K $\Omega$  resistor".Theory SectionThis section deals mainly with the main theory of the experiment. You have to write the main theory you are going to prove. In this case, maybe you have to write the exact same theory. But is not going to be considered plagiarism because you are using that exact theory as an experiment subject. At the end of this section, you have to explain what we need to analyze to prove that the theory is right.List of components (Equipment) SectionIn this section, we write the list of components used in the experiment. This section is an important section because it contains information about all machines or components we need. All kinds of physics lab experiments need some components or machines.Diagram SectionThis section basically contains the diagram or picture of the whole experiment. This part gives you an idea of how the experiment was done. In most cases, the diagrams are presented by the students themselves with the help of pencils, but in some cases, the diagrams may have been created using different software. It depends entirely on how the institution wants the diagrams.Steps SectionThis section provides an overview of the various steps involved in conducting the experiment. This section describes how a student took the test and what steps he followed. Of course it is important to keep this part because it allows someone else to understand how the experiment was done.Data Table SectionIf an experiment is dealing with different mathematical problems, then the data table is a very important part. Different readings of the experiment are kept in the data table and some more information is obtained from them with the help of formulas. From there, it is possible to prove a theory from an experiment.Graph SectionWe have to draw graphs in many experiments. Basically, different information can be presented very easily through graphs. Therefore, in all the experiments in which graphs can be used, graphs must be used. Through this, the lab report can be presented in a much better way.Result SectionThis section discusses what we can conclude from an experiment. A conclusion can be reached by taking data from the data table and doing various calculations with the help of mathematical formulas. This is an important part of the lab report. The calculations and the presentation should be done carefully.Conclusion SectionThis section presents what we have learned from the experiment. It tells us what we have learned from the results and what has been proved by the results. That is why this part should be written seriously so that we can get an idea of what we have got from the experiment.Physics Lab Report ExamplesHere is some example of the physics lab reports. Follow those examples to create your lab report. Frequently Asked Questions about Lab ReportWhat size paper should the lab report be written on?You can use any type of paper, but in this case, A4 size paper is the most used. Since this is a document, A4 size is the most acceptable paper size. However, other papers can be used for drawing graphs and diagrams. After completing the work should be submitted in the form of spiral binding or file.Can data collected by others be used to create lab reports?Lab reports are primarily given to students so that they can get an accurate idea of the whole topic. We will not experiment on our own when we collect data from others. By doing this we will be left behind and will not be able to understand the topic properly. So of course it would be wise to collect the data by experimenting on your own. However, if someone has experimented with data from others and made some changes, in most cases it is not considered a mistake or a crime. Students are strongly encouraged to write their reports in the order detailed on the diagram above. Labs will be graded utilizing the attached rubric. I. Title Page Name of lab, name of student, period, date, instructor. II. Introduction Describe what concept the lab explores, and presents the objectives and purpose of the lab. Also states the research problem and the reason this problem is being investigated. IV. Methods / Procedure Document your experimental procedure in enough detail that someone else could repeat your work. This should include a list of all materials used, a diagram of the lab setup if appropriate, and the steps taken to accomplish the lab (paragraphs preferred, but organized, ordered lists of instructions are acceptable with list items in complete sentences.) A. Materials List all materials used. B. Diagram of Lab Setup Show schematic of experimental setup where necessary. C. Steps Taken Provide enough information that another student could easily replicate your work. V. Results / Data Put your data into tables and graphs which are appropriately labeled and explained. Review your tables and graphs to determine the key findings from the lab exercise. Write a paragraph explaining each table and graph including its key result and other salient details. Arrange the results section in an organized fashion. A. Data Tables Organized and labeled with units. B. Graphs Properly label all axes, provide appropriate title. C. Explanations The key relationship from each table or graph is described in a separate paragraph with appropriate supporting details. VI. Discussion / Analysis Open with a statement of key findings, and clearly reference those findings with data from the lab. Provide logical explanations for all statements. Discuss other appropriate findings of interest. Make sure you have answered all analysis questions, and you have answered your research problem as posed in the introduction. VII. Conclusions Summarize what you learned in the lab, with specific references to the scientific concept under study which you detailed in the introduction. Describe potential sources of error (don't say human error). Critique the lab and describe opportunities for further / future work. Did you learn anything else from the lab, such as use of lab equipment, procedures, analysis methods, etc.? Important Notes: Reports MUST be type-written. Write the lab sections in this order, then rearrange the sections into a cohesive report and print before turning in to your instructor: Procedure, Results, Introduction, Discussion, Conclusion, and Title Page. Write in the 3rd person: Avoid 1st and 2nd person references such as I, we, you, and you(understood). Use a clear font with a maximum point size of 12. Diagrams and graphs MAY be neatly hand-written and glued in place (leave blank space in report). \*Adapted from NC State University's LabWrite Program, © 2004 NC State University A laboratory is a place or facility where most research and experiments because it provides an area with a controlled environment or controlled condition that is ideal or conducive to performing experiments. There are many kinds of laboratories for different fields of science and research. A physics laboratory is where physics experiments and researches are done. This is also the place where a physics report is started. The physics lab report is where the procedures and data gathered in an experiment is recorded and then presented. A physics lab report has a variety of uses. To know of these uses, here are sample lab reports that will help further your understanding about them. Physics Lab Report Samples1. Sample Physics Lab Report FormatDetailsFile FormatSize: 9 KBDownloadA lab report is where you record or document all of your observations, findings and gathered data from an experiment you just performed, aside from detailing the procedures done. These things can be made easier if you already have a report format or a report template prepared before hand. If you still haven't, here's a sample that you can look into and even use as your own. This is a customizable and print-ready sample that will make your life easy. Try using this one now!2. Sample Physics Lab Report and GuidelinesDetailsFile FormatSize: 308 KBDownloadIn order to make uniform lab reports, specific guidelines must be provided and followed. This sample report above works both as a sample and as a guide at the same time. The first part of the document details the guidelines on how the report should be done or written, and provides the desired structure or format for said lab report. The next few pages is a sample lab report on Hooke's Law.3. Physics Lab Report Outline SampleDetailsFile FormatSize: 352 KBDownloadIt is important to properly format your lab report so that it can be easily read and understood by your readers. If you have no idea how it's done, you can use lab report outline templates to help you, just like this physics lab report outline above. The sample outline will not only give you an idea on how the report should look like, but it will also teach you on how you should write the report. This is just a wonderful reference material you should not miss.4. Physics Laboratory Report SampleDetailsFile FormatSize: 98 KBDownloadWe will be talking about physics lab reports throughout this article so you'll be able to get tons of samples that will help you with your needs. And talking about physics, who would forget about Newton's second law? If this sample report is all about it. If you have similar needs, then this sample will do you some good. It is six pages in total and includes an introduction, Experimental Procedure, Discussion, Summary of Measurements, tables and graphs that represent data, etc..5. AP Physics Lab Report Format SampleDetailsFile FormatSize: 83 KBDownloadAP physics or advanced placement physics is a course that is equivalent to that of first semester algebra in college. So if you need to write this kind of report, you may use the sample report format. What is included in this sample? The sample provides a list of the different parts of the report as well as a description of each part or section, namely the introduction, experimental procedure, experimental data, analysis, conclusion, and appendices. A scoring rubric is also added on the last page showing how the entire lab report is graded.6. Formal Lab Report SampleDetailsFile FormatSize: 74 KBDownloadJust like a formal letter, a specific format is used in writing a formal lab report. The specifications include lab preparations; paper size, orientation and margin; title page specifications; report objectives; introduction; materials; procedures; results; conclusion, etc. The specifications must be followed and the parts of the report must be present to ensure the report is complete. You will surely find this report sample useful.7. Printable Physics Lab Report SampleDetailsFile FormatSize: 186 KBDownloadThis is another lab report sample that will guide you with writing your own lab report. This sample and guide is detailed and comprehensive allowing to come up with a well-written and reliable lab report. Every part or section of the report is listed and thoroughly explained to help you write relevant and high-quality content in your report. Other report samples that you may find useful, include technical report samples and business report samples.8. Sample Short Lab ReportDetailsFile FormatSize: 107 KBDownloadNot all lab reports are the same, just like not all lab reports are lengthy. This is a sample of a short lab report. Just because it's short doesn't mean that it's no longer detailed and reliable. Short lab reports only include details that are essential to the experiment being reported so it still provides all the information that there is to know. The sample lab report above is about kinetic friction. If you have the same or similar needs, you may as well use this report sample as reference in writing your report.9. Sample Lab Report TemplateDetailsFile FormatSize: 102 KBDownloadThere are different lab report templates for different fields of work. That is because a chemistry lab report is done differently from that of a physics lab report. This is a sample of a physics lab report template. The template is simple and the different sections of the report are clearly written so that they can be easily identified from the rest of the texts. Under each section or part are bullets that describe or explain what goes under that section. We highly recommend using this template.10. Principles of Physics Lab Report SampleDetailsFile FormatSize: 76 KBDownloadThe lab report above is about the principles of physics. It consists of two parts, namely content and format, and the grading part. It is a pretty simple lab report sample that is ideal for use as a reference or guide for those who want to write better lab reports.

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